Gas Centrifuge Enrichment

Licensing Reviews

AREVA NC Gas Centifuge Facility

LES Gas Centifuge Facility

USEC Inc. Gas Centrifuge

Related Information

FAQ

Fact Sheet on Gaseous Diffusion

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Frequently Asked Questions About Gas Centrifuge Enrichment Plants

Uranium enrichment is one step in the process of manufacturing fuel for nuclear reactors. The questions and answers on this page provide information about one method of enriching uranium using centrifuges.

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What is the uranium enrichment process?

For the types of nuclear power plants used in the United States, uranium needs to be enriched to produce power. Natural uranium primarily contains two isotopes, U-238 (99.3 percent) and U-235 (0.7 percent). The concentration of U-235, the fissionable isotope in uranium, needs to be increased to 3 to 5 percent for practical use as a nuclear fuel. This enrichment can be performed in several ways -- gaseous diffusion and gas centrifuges are the principal methods. In gaseous diffusion, uranium is converted into a gaseous form, uranium hexafluoride (UF6), and passed through many stages of barriers that separate the uranium isotopes. In the United States, gaseous diffusion plants have operated in Oak Ridge, Tennessee; Paducah, Kentucky; and Piketon, Ohio. Currently, the only operating enrichment plant in the United States is the plant in Paducah, Kentucky. Another way to enrich uranium is by using gas centrifuges. Gas centrifuges spin UF6 gas at high speeds creating a centrifugal force that separates the isotopes by forcing the heavier U-238 further outward in the centrifuge. Gas centrifuges have been used in Europe for about 30 years for enriching uranium.

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What are the principal hazards at an enrichment facility?

The principal hazards at an enrichment plant are the chemical hazards in handling UF6. When UF6 contacts moisture in air, it reacts to form hydrogen fluoride and uranyl fluoride. The chemical hazards of compounds of uranium in soluble form such as UF6 and uranyl fluoride are much greater than the radiological hazards of those same compounds. In addition, hydrogen fluoride can be very dangerous if inhaled; inhalation is the principal hazard at an enrichment plant. These hazards are controlled by plant design and administrative controls to confine soluble uranium compounds. The radiological hazards are relatively low and containers of natural, enriched, and depleted uranium can be handled without additional shielding.

Transportation of UF6 to and from the enrichment plant is regulated by the U.S. Department of Transportation and the NRC. Requirements for shipping UF6 are generally equivalent to requirements for shipping nonradioactive corrosive materials.

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What will happen to the waste products from the enrichment process?

Enrichment processes generate a product of 3 to 5 percent U-235 for use as nuclear fuel and a product of depleted uranium (about 0.3 percent U-235). The depleted uranium has some commercial applications in counterweights and antitank armaments. However, the commercial demand for depleted uranium is much less than the amounts generated (the U.S. Department of Energy [DOE] has about 750,000 metric tons of depleted uranium in storage). Under the U.S. Enrichment Corporation (USEC) Privatization Act, DOE is required to accept depleted uranium from an NRC-licensed uranium enrichment facility if the depleted uranium is determined to be low-level radioactive waste. NRC considers depleted uranium that has no commercial value to be low-level radioactive waste. If the depleted uranium has no commercial use, the licensee can transfer the material to DOE or dispose of it at a commercial disposal site if it meets the disposal sites requirements. Under the USEC Privatization Act, the licensee must reimburse DOE for its costs.

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What projects are planned for gas centrifuge enrichment in the U.S.?

Three companies are planning on constructing and operating gas centrifuge enrichment facilities: USEC Inc. (USEC), Louisiana Energy Services (LES) and AREVA NC. USEC's program consists of three phases: a demonstration program, a Lead Cascade phase, and a commercial deployment phase. The demonstration phase is intended to obtain detailed test data for the gas centrifuge machines. The Lead Cascade phase is intended to provide reliability information on the machines as they would be used in commercial operations. USEC submitted an application for operation of the Lead Cascade facility in February 2003 and NRC issued a license to operate the Lead Cascade in February 2004. The Lead Cascade facility will be located in Piketon, Ohio. USEC submitted an application to operate the commercial facility, the American Centrifuge Plant (ACP), in August 2004. The NRC issued a license for the ACP in April 2007. The facility is currently under construction.

LES submitted a license application to NRC in December 2003. Full capacity is expected to be 3 million SWU/year, which is about one-third of the United States' current nuclear fuel demand. This facility is in Lea County, New Mexico. NRC issued a Final Environmental Impact Statement (EIS) and Safety Evaluation Report (SER) for the facility in June 2005. In June 2006, NRC issued LES a license to construct and operate its facility. The facility is currently under construction.

AREVA NC intends to apply for a license from the Nuclear Regulatory Commission to construct and operate a gas centrifuge facility in the United States in 2008. AREVA NC has not yet selected a site for this proposed facility.

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What is the Nuclear Regulatory Commission's (NRC's) role in the construction and operation of gas centrifuge enrichment plants?

Under the Atomic Energy Act, as amended, NRC must license a uranium enrichment plant under 10 CFR Parts 40 (source material) and 70 (special nuclear material). Before an applicant can begin construction of a plant, NRC must issue a license for construction and operation. To issue a license, NRC must prepare an environmental impact statement (EIS) for the project and a safety evaluation. NRC must also conduct a formal hearing before issuing a license.

An application for a test or laboratory scale facility does not require an EIS or a mandatory hearing, and there are no restrictions on beginning construction. The NRC's preliminary review indicates that the Lead Cascade facility proposed by USEC is a small-scale test and demonstration facility and not a full-scale production facility.

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Why is a test facility treated differently in the licensing process?

The definition of a uranium enrichment facility in 10 CFR 70.4 specifically excludes laboratory scale facilities used for experimental or analytical rather than production purposes. Operation of laboratory facilities does not involve the withdrawal of enriched uranium products. In the case of the Lead Cascade facility proposed by USEC, no product would be extracted from the process, with the exception of approximately 3 to 5 grams of uranium that would be removed daily for sampling. Clearly, the NRC would still subject USEC's Lead Cascade facility application to thorough safety, security, and environmental reviews.

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What will happen in the NRC's licensing process?

On receipt of a license application, NRC staff will conduct an acceptance review of the application to ensure that it contains sufficient information to begin its review. NRC staff will also conduct a security review of the application before making it publicly available. The security review will determine if any parts of the application could compromise national security if released. If the application is acceptable, it will be formally docketed and non-classified portions will be made publicly available in the Agencywide Documents Access and Management System (ADAMS) and the NRC's gas centrifuge licensing page. Shortly after docketing, NRC will issue, in the Federal Register, a notice of opportunity to petition for a hearing. By "hearing," NRC is referring to a formal judicial process before a single or panel of administrative law judges set up to address NRC licensing issues. At this time, NRC staff will also begin its environmental review.

If an EIS is to be prepared, shortly after the application is docketed NRC staff will conduct an EIS scoping meeting near the proposed site to allow the public an opportunity to suggest areas to be addressed in the EIS. Following the scoping process, NRC will prepare a draft EIS and offer a formal opportunity to comment on it. Again, NRC staff will meet with the public to accept comments on the draft EIS. Written comments will also be accepted. The EIS process is expected to take approximately 20 months. If an EIS is not required, the NRC will prepare an Environmental Assessment (EA). Preparation of an EA does not require a scoping process but does provide an opportunity for the public to comment. The EA process is expected to take up to 12 months.

The technical review of a production facility is expected to take 18 to 20 months to complete and will determine if the proposed project meets the NRC's safety and security requirements. The technical review of a test and demonstration facility is expected to take up to 12 months. The time difference is primarily determined by the requirement to conduct a hearing.

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How do these projects relate to the enrichment plant in Paducah, Kentucky?

The enrichment plant in Paducah, Kentucky, uses the gaseous diffusion method for enriching uranium. This plant was built in the early 1950s and was originally operated by DOE and its predecessor agency, the Atomic Energy Commission. In the 1990s, Congress transitioned the plant from DOE control to a Federal corporation, the U.S. Enrichment Corporation (USEC). In 1998, USEC was privatized. USEC is a competitor of LES in the worldwide uranium enrichment market. There is no other relationship between the two entities.

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Has NRC ever denied a license?

NRC has denied several licenses. These include the following applications:

1. 1988, radiography application
2. 1989, well logging application
3. 1989, gemstone radiation application
4. 1999, chemical agent detector application

Also, in 1999, NRC denied an application for a sealed source registration certificate for a mobile irradiator. In another case, the NRC denied a license renewal for a manufacturer of irradiators used in medicine. In most cases, applications are withdrawn when an applicant realizes that it cannot meet NRC licensing requirements.

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Did the NRC deny the previous LES license application?

In January 1991, the NRC received an application from LES to construct and operate the nation's first privately owned gas centrifuge enrichment facility. The 1.5 million Separative Work Unit (SWU) plant was to be built in Homer, Louisiana. As a result of an extended licensing hearing process, LES decided to withdraw its application in 1998. The last hearing issue being litigated was the environmental justice issue related to the proposed site being located between two rural, minority communities and how travel between the communities would be affected.

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What is the Department of Energy's role in providing the centrifuge technology and facility to USEC?

In June 2002, USEC and DOE signed an agreement that allows USEC to use DOE gas centrifuge technology and provides a schedule for development of the Lead Cascade and commercial-scale facilities. On September 19, 2002, USEC and DOE announced the signing of a Cooperative Research and Development Agreement that would allow USEC to further develop DOE's gas centrifuge technology. USEC located the Lead Cascade in an existing DOE gas centrifuge building at the Portsmouth Gaseous Diffusion Plant (GDP) site in Piketon Ohio.

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Will the applicants' financial condition be taken into consideration in reviewing the license applications?

Yes. NRC regulations in 10 CFR Part 70 require all applicants to be financially qualified to safely construct, operate, and decommission the proposed facilities.

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